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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/816,503	04/01/2004	Hong-Jyh Li	2004P51130US/I331.128.101	8623

7590 11/30/2007
Dicke, Billig & Czaja, PLLC
Suite 2250
Fifth Street Towers
100 South Fifth Street
Minneapolis, MN 55402

EXAMINER

JOHNSTON, PHILLIP A

ART UNIT	PAPER NUMBER
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2881

MAIL DATE	DELIVERY MODE
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11/30/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/816,503

Applicant(s)

LI, HONG-JYH

Examiner

Phillip A. Johnston

Art Unit

2881

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 14 September 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3-9,11-25 and 27-31 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,3-9,11-25 and 27-31 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 01 April 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

Detailed Action

1. This Office Action is submitted in response to Amendment filed 9-14-2007, wherein claims 1,8,16, and 25 have been amended and claims 2,10, and 26 are canceled. Claims 1,3-9,11-25, and 27-31 are pending.

Examiners Response to Arguments

2. Applicants arguments are moot in view of new grounds for rejection necessitated by the applicant's amendment.

Claims Rejection – 35 U.S.C. 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 1,8,16, and 25 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contain subject matter, which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Particular subject matter contained in amended claims 1,8, and 25 includes the limitation "a plasma generator configured to generate ions other than N in the vacuum chamber".

A review of the specification and drawings has indicated a complete absence of any description relating to "generating ions other than N "; that is, excluding the use of nitrogen. In fact paragraphs [0031], [0032], [0036], [0047]-[0049], [0056], and [0065] of the specification reveals that N is included in every group of ions. In addition,

paragraphs [0037] through [0041] describe a process for fabricating transistor cell 40, each of which includes a description of nitride layer 72.

Although one skilled in the art of ion implantation would recognize that the use of a particular ion is dictated by design choice, the applicants disclosure does not provide any description to support the exclusion of N, as defined by the amended claim limitation " a plasma generator configured to generate ions other than N ", nor its importance to the performance of the invention as stated in applicants remarks filed 9-14-2007.

Similarly, regarding the elimination of P and As from the generated ions in claim 16, a review of the specification, particularly paragraph [0029] describes transistor cell 40 having source 46 and drain 50 doped with arsenic, phosphorous, boron or other suitable material, depending upon the desired transistor characteristics. And again, the specification does not contain any description excluding the use of phosphorous and Arsenic.

As a result, the examiner has interpreted that the specification does not contain clear, concise, and exact terms that would enable any person skilled in the art to make and use the now claimed invention.

Claims Rejection – 35 U.S.C. 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was

made to a person having ordinary skill in the art to which the subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 1,4-9,12,25,28 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,518,195 to Collins, in view of Jeon, U.S. Patent No. 6,790,755.

7. Regarding claims 1 and 8, Collins teaches plasma reactor 10 (Note Figure 1 below) having the following claimed elements;

(a) Vacuum chamber 11. Col. 7, line 8-11;

(b) Vacuum pump 21. Col. 7, line 28-33;

(c) Gas supplied through manifold G1. Col. 7, line 35-50;

(d) Plasma chamber 16A for coupling RF electromagnetic (em) energy into the source chamber 16A (plasma generator) to induce electric fields to ionize the process gas. Col. 8, line 39-53;

(e) Plural power supplies (voltage sources), where AC supply 31 provides RF for plasma generation to antenna 31 at the top of the chamber and at the bottom, power supply 42 provides a constant positive or negative DC bias between the sample holder and the chamber wall (Col. 11, line 60-67), where a negative bias extracts positive ions toward (accelerate) wafer 5, and repels negative ions; and

(f) Wafer support electrode 32C (sample holder). Col. 8, line 55-60;

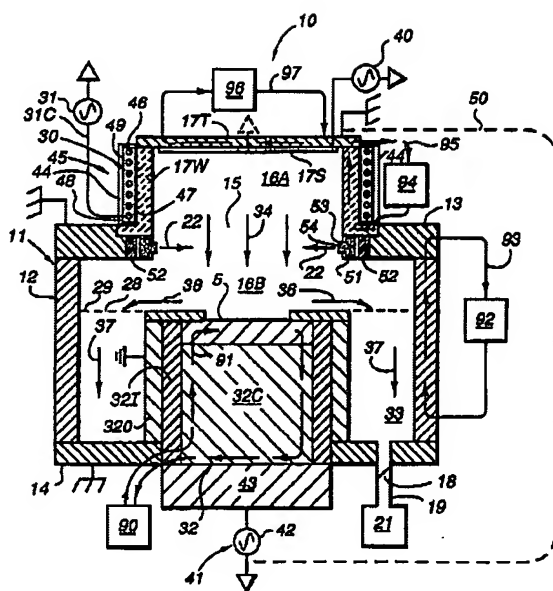


FIG. 1

8. Collins teaches all the required limitations of claims 1 and 8, as pointed out above.

9. Collins fails to disclose implanting ions into a high-k dielectric layer having a k value greater than 9.

10. Jeon teaches ion implantation after deposition of alternating sub-layers of high-k dielectric and areard-k dielectric materials on a semiconductor substrate. The high-K dielectric materials have a K value of about 20 or more. Such high-K dielectric materials include, for example, HfO_2 , ZrO_2 , and Ta_2O_5 . Col. 4, line 1-10; Col. 14, line 9-20.

11. Jeon modifies Collins to provide nitridation of high-k dielectric layers to produce semiconductor devices having the electrical advantages of a higher K.

12. Therefore it would have been obvious to one of ordinary skill in the art that the plasma reactor apparatus of Collins can be modified to use ion implantation of high-k layers in accordance with Jeon, to provide a semiconductor device having a composite dielectric layer, where the composite dielectric layer is formed about the boundary of each first dielectric material layer/second dielectric material layer.

13. Regarding claims 4-7, Collins teaches power supply 42 is also configured to supply AC voltages. Col. 8, line 55-60.

14. Regarding claim 9, Collins teaches that voltage sources are connected to the holder and the chamber, as described above regarding claims 1 and 8.

15. Regarding claim 12, Jeon teaches the use of HfO_2 , ZrO_2 , and Ta_2O_5 , as described above regarding claims 1 and 8.

16. Regarding claim 25, the combination of Collins and Jeon teaches the apparatus used in this method claim, as described above regarding claims 1 and 8. Collins also teaches evacuation of the interior of the chamber housing 11 (chamber 16) controlled by a throttle valve 18 in a vacuum line 19 connected to vacuum pumping system 21. Col. 7, line 28-33.

17. Claims 3, 11, 13-24, and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over USPN 6,518,195 to Collins, in view of Jeon, USPN 6,790,755, and in further view of USPN 2001/0054746 to Yamada.

18. Regarding claims 3, 11, 16, and 27, the combination of Collins and Jeon teaches all the required limitations therein as pointed out above regarding claims 1

and 8, but fails to teach implanting ions comprising one of F, Si, O, Hf, Zr, Ti, Ta, Y, V, Sc, Ba, Sr, Ru, B, Al, Ga, In, Ge, C, and Sb.

19. Yamada teaches ion-implanting boron (B). See [0129].

20. Yamada modifies Collins and Jeon to provide ion-implantation of p-type impurities into poly-silicon base region 9 in the depth direction in high concentration.

21. Therefore one of ordinary skill would select an ion to be implanted from the group above in order to provide doping levels for production of semiconductor devices with desired characteristics.

22. Regarding claims 13-15 the combination of Collins and Jeon teaches all the required limitations therein as described above regarding claims 1 and 8, but fails to teach the use of a buffer layer.

23. Yamada teaches a buffer layer 6 that is a semiconductor buffer layer such as amorphous silicon or epitaxially grown single crystal silicon, silicides, or metals, or insulating films of BSG (boron silicate glass), where the silicide or the metal particularly contributes to decreasing the resistance of the external base. See [0128] and [0141].

24. Yamada modifies Collins and Jeon to provide a method for making a silicide buffer layer, where a metal such as titanium (Ti) or cobalt (Co) stacked by sputtering, for example, is annealed by RTA (rapid thermal annealing) for a short time to make the metal and silicon react forming TiSi. [0161]

25. Therefore it would have been obvious to one of ordinary skill to provide plural buffer layers on silicide stacks that include metals such as titanium (Ti) or cobalt (Co), and implanting ions in the buffer layers to adjust doping levels.

26. Regarding claim 17, the rational applied above to claim 16 also applies to claim 17. The combination of Collins and Jeon teaches plasma processing of large semiconductor wafers, which inherently includes a pattern of adjacent devices, thus would also include the use of adjacent high-k dielectric layers.

27. Regarding claims 18 and 19, the combination of Collins and Jeon teaches all the limitations therein as pointed out above regarding claim 16.

28. Regarding claims 20-22, the rational applied above regarding claims 13-15, also applies to claims 20-22. In particular, the teaching of a buffer layer in Yamada.

29. Regarding claims 23 and 24, the rational applied above to claims 4-7, and 16, also applies to claims 23 and 24. Particularly, the teaching of plasma voltage sources in Collins.

30. Regarding claim 27, the rational applied above to claim 25, and claims 3 and 11, also applies to the recitation of the same group of elements in claim 27.

31. Regarding claims 28 and 29, the rational applied above to claims 4-7, and 25, also applies to the same recitation of voltage sources in claims 28 and 29.

32. Claims 30 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Collins and Jeon in view of USPN 6,248,662 to Wu.

33. Regarding claims 30 and 31, the rational applied above to claim 25 also applies to the structural elements of claim 30, but fails to teach the use of an

implanting ions with an energy range of 5-10 kev and dosages greater than 1×10^{13} ions/cm² and less than 1×10^{16} ions/cm².

34. Wu teaches the use of an ion implantation sources where BF₃ ions are implanted at a typical dosage of about $1.0E^{16}$ /cm³ and a typical energy of about 5.0 KeV. Col. 3, line 5-17.

35. Wu modifies Collins and Jeon to provide an ion source where the energy of the implanted ions is restricted so that the implanted ions are only concentrated in the surface of the first dielectric layer, and the dosage of implanted ions is adjustable.

36. Therefore it would have been obvious to one of ordinary skill to implant ions at energies and dosages that have been selected to form void-free dielectric layers.

Conclusion

37. The Amendment filed on 9-14-2007 has been considered but the arguments are moot in view of new grounds for rejection.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not


mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

38. Any inquiry concerning this communication or earlier communications should be directed to Phillip Johnston whose telephone number is (571) 272-2475. The examiner can normally be reached on Monday-Friday from 7:30 am to 4:00 pm. If attempts to reach the examiner by telephone are unsuccessful, the examiners supervisor Robert Kim can be reached at (571) 272-2293. The fax phone number for the organization where the application or proceeding is assigned is 571 273 8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

PJ

November 15, 2007


Jack I. Berman
Primary Examiner